The complex-network based relation between migration and FDI in the OECD

Antonios Garas and Athanasios Lapatinas and Konstantinos Poulios

Chair of Systems Design, ETH Zurich, Department of Economics, University of Ioannina, Department of Economics, University of Ioannina

10. December 2015

The complex-network based relation between migration and FDI in the OECD

Antonios Garas

Chair of Systems Design ETH Zurich, Weinbergstrasse 56/58, CH-8092 Zürich

Email: agaras@ethz.ch

Athanasios Lapatinas[1]

Department of Economics, University of Ioannina, P.O. Box 1186, 45110, Ioannina, Greece

Email: alapatin@cc.uoi.gr

Konstantinos Poulios

Department of Economics, University of Ioannina, P.O. Box 1186, 45110, Ioannina, Greece

Email: konstantinos.poulios.10@mail.wbs.ac.uk

Abstract

We explore the relationship between human migration and OECD's Foreign Direct Investment (FDI) using a complex systems' approach, and we demonstrate how complex systems' techniques can contribute new insights and advance macroeconomic empirical analysis in alternative ways. More precisely, we find a strong correlation between the migration network and the outward-FDI network, and we highlight the existence of a weaker FDI relationship in pairs of countries that are more central in the migration network. Illuminating this result, we show that inward migrants coming from third-party countries which are linked (a) either to FDI-parent country or to FDI-host country or (b) both to FDI-parent and FDI-host country are FDI marring.

Keywords: FDI; migration; graph theory; complex systems.

JEL: B00, B41, C13, F2

[1] Corresponding author.

1 Introduction

During the past decades there was a huge flow of people, capital and knowledge around the world, which can be mainly attributed to human migration across borders and Foreign Direct Investment (FDI). And while throughout the literature it has been of major interest to explore the mechanisms of globalization, little attention has been paid in answering the question of whether immigration is related to FDI. Only a small part of the literature (see next section) has explored so far possible links between FDI and migration, suggesting that cross-border capital flows are affected by bilateral migration. As argued, the migration of people brings to the destination country factors of production, like capital and labor, but also a social network connected to immigrants' origin country. These social networks may lower potential barriers to international investment, as immigrants possess crucial information about the structure of the local market, the preferences, as well as the business ethics and the commercial codes. This knowledge can be proved invaluable for overcoming many informational and contractual barriers, leading to stimulated investment activities across national boundaries.

Whereas previous studies have focused on migrants within a single country, this is a work analyzing migration and FDI between many countries. The paper brings together a wide range of bilateral migration, FDI positions, geopolitical, demographic, economic, and socioeconomic data for 30 OECD countries around the year 2000 and investigates if migrant networks do reduce contractual and informational barriers between countries.

More precisely, the current paper contributes to the existing literature by investigating the topological properties of the OECD's outward FDI network and the OECD's migration network. Considering both a binary and a weighted network approach, we use a complex-network perspective in order to study the correlation patterns of the two networks (see Fagiolo and Mastrorillo, 2014, for an analysis that explores similar issues using a trade perspective instead of FDI). First, we scout the patterns of correlation between the two networks by comparing link weights, topological structures and node statistics, finding a strong correlation which can be mostly explained by countries' economic, demographic and geographical differences. Then, we add migration-network variables in a gravity regression equation of outward FDI stocks/positions while controlling for countries' network-centralization and the intensity of common as well as non-overlapping inward migration channels. We find that pairs of countries

that are more central in the migration network are less FDI related. Furthermore, we highlight the existence of a negative and statistically significant relationship between the intensity of both the common and the non-overlapping migration channels of countries with outward FDI: inward migrants coming from third-party countries can be FDI marring, in addition to common inward ones.

The remainder of the paper is structured as follows. The next section briefly reviews the related literature. Thereafter, section 3 describes our dataset and visualizes the two networks, while section 4 presents the topological properties of the two networks. The empirical results are discussed in Section 5. Finally, section 6 concludes our analysis.

2 Related Literature

The literature linking FDI and migration is relatively scarce and usually refers either to within a particular country's migrants affecting bilateral investment with their country-of-birth, or to the migrants from a particular country living in a number of other countries affecting capital flows between those other countries. The workhorse gravity equation model for bilateral trade flows is increasingly used to analyze FDI (Wei, 2000; Razin and Sadka, 2007; Blonigen et al. 2007). Bergstrand and Egger (2007) and Head and Ries (2008) develop the leading theoretical models that provide theoretical micro-foundations for adopting gravity equations for the analysis of FDI.

Clemens and Williamson (2000) find that, historically, British foreign capital flowed into countries that also attracted a large number of migrants. In the same line, Barry (2002) use aggregated data to show that migration has an impact on inflows of FDI, while Gao (2003) finds that FDI into China is positively related to the share of the Chinese population in the FDI-parent country. Hunt (2004) finds that migration within Germany often takes the form of same-employer migration and Tong (2005) shows that the number of ethnic Chinese in both the FDI-parent and the FDI-host country is positively correlated with the cumulative amount of their reciprocal FDI. Kugler and Rapoport (2005) find a positive impact of the change in immigrants from a particular origin-country into the US on outward FDI of US firms into this country. Buch et al. (2006) show that there are higher stocks of inward FDI in German states hosting a large foreign population from the same country of origin, while Kugler and Rapoport (2007) demonstrate that migration and FDI inflows are negatively correlated contemporaneously but

migration is associated with an increase in future FDI. Bhattacharya and Groznik (2008) find that US outward foreign investment in a country is higher the higher the income of the immigrant group from that country living in the US is. Furthermore, Ligthart and Singer (2009) investigate the role of immigrants in Dutch outward FDI and find that they facilitate outward FDI to their countries of origin.

More recently, Leblang (2010) tests the hypothesis of whether diaspora networks influence cross-border investment by reducing transaction and information costs. He uses dyadic cross-sectional data for portfolio and FDI and he finds a substantively and statistically significant effect of diaspora networks on global investment. Moreover, Javorcik et al. (2011) investigate the link between the presence of migrants in the US and US FDI in the migrants' countries of origin, addressing potential endogeneity of migration with respect to FDI by employing the instrumental variables approach. They conclude that the presence of migrants in the US increases the volume of US FDI in their country of origin. Foley and Kerr (2011) using firm-level data show that firms employing high-skilled labor from foreign countries increase both their FDI and their patening activity in these countries. Flisi and Murat (2011) focus on the relation between bilateral FDI and skilled and unskilled immigrants and they observe that FDI of UK, Germany and France is prompted by the ties of skilled immigrants, while the FDI of Italy and Spain is only influenced by their respective diasporas. Finally, Foad (2012) improves identification issues by looking at the US-regional distributions of FDI and immigration. Using a unique measure of immigrant network size for each US-state, he finds that immigration tends to lead FDI.

Regarding the complex-network perspective of our approach, to the best of our knowledge although the topological properties of the international-migration network and its evolution over time has been explored (Fagiolo and Mastrorillo, 2013), such an investigation is missing for the FDI network. The current paper not only explores the topological properties of the OECD's outward FDI network but it does so by jointly investigating FDI and migration as dependent phenomena i.e. as if they were two fully connected layers of the directed-weighted multi-graph where nodes are world countries and links represent their macroeconomic interaction channels (Schweitzer et al., 2009).[2]

[2] See also Battiston et al. (2007) for a complex-network based analysis of inter-regional investment stocks within Europe.

3 Networks' Data and Visualization

This section outlines the data sources on migrant numbers, FDI stocks and other explanatory variables. An outward investment and migration cross-section was constructed for 30 OECD countries and up to 242 partner countries (totaling 2,155 observations after excluding the non-available values) around the year 2000.[3] FDI positions were sourced from the *OECD International Direct Investment Database*. Data are presented in millions of US dollars.[4] The 30 OECD countries included in the database hosted 71% of global inward FDI and were the source of 87% of global outward FDI in 2000 (UNCTAD, 2006).

Furthermore, we retrieve origin-destination (bilateral) migration data, for all the countries in the FDI dataset, from the *Global Migration Origin Database* of the *Development Research Centre on Migration, Globalization and Poverty (Migration DRC)*. The database extends the basic stock data on international migration published by the United Nations. The data are presented in units of migrants and are obtained from the census undertaken in each country closest to 2000, identifying migrants by country of birth (Parsons et al., 2007).

In our regression analysis below, we use bilateral country geopolitical and socioeconomic data published by *CEPII* (see www.cepii.fr). The variables are included in *CEPII's* gravity and geodist datasets and contain information about between-country geographical distance, contiguity i.e. whether two countries share a border, whether the two countries have ever had a colonial link, share a language, a currency, or have a common legal system. The variables also provide information on economic partnership, trade and tariff agreements, as well as on countries' areas and time zone differences. The remaining control variables, populations and GDP per capita, were taken from the *World Development Indicators* published by the *World Bank*.

We use outward FDI positions and bilateral migration data to build two weighted-directed networks wherein between any two nodes there can be at most two weighted-directed links which describe outward capital movements and bilateral migration respectively. The generic element of the FDI network (FDIN) records the log of outward FDI stocks/positions, FDI_{ij}: the

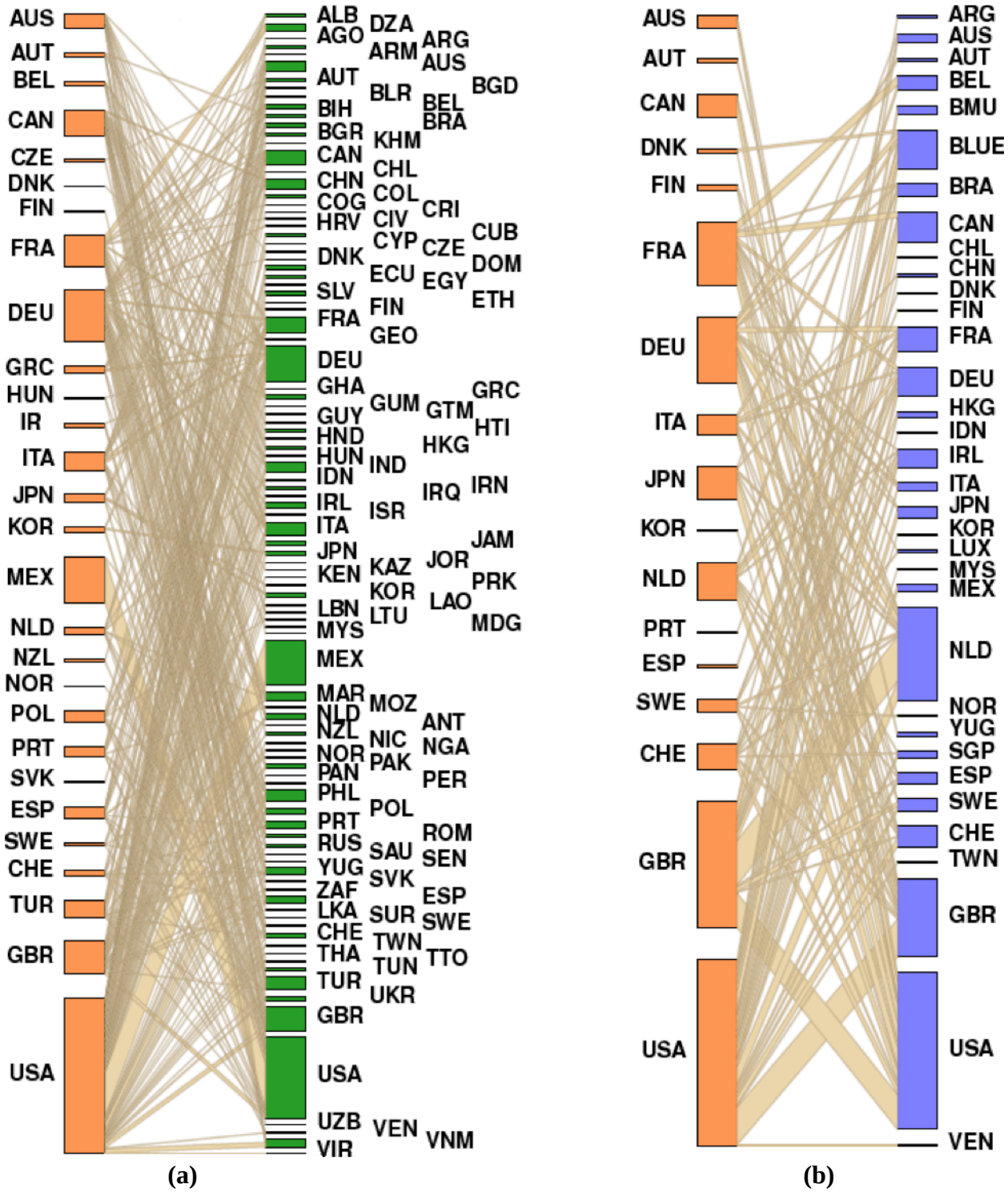
[3] We focus our analysis on the year 2000, the latest year for which we have available data for both migration and FDI.

[4] Details on the data may be found at stats.oecd.org.

stock of FDI that country i owns in country j, where the index i denotes the 30 OECD parent countries and the index j denotes the 242 host countries for FDI for which we have matched data for the year 2000. On the other hand, the generic element of the migration network (MN) represents the stock of migrants, m_{ij} , originated in country i and present at year 2000 in country j. Accordingly, we define the binary projection of the two networks through their adjacency matrices, where their generic elements are equal to one if the correspondent entry in the weighted version is strictly positive.

Figure 1 shows the undirected version of (a) the migration network and (b) the outward FDI network in year 2000 for the top 5% of link weights, with node size drawn scaled proportionally to its strength. Figure 1 illustrates the central role of US in the migration network and the strong capital bonds between US and Great Britain. The Netherlands seem to host a considerable portion of OECD's FDI stock originated mainly from US, Great Britain and Germany. Notice also the substantive presence of low-income countries in the migration network, while the most important capital movements emanate from prosperous countries.

Figure 1. The Migration Network (a) and the FDI Network (b) in year 2000.



Notes: Only the top 5% of the networks' link weights are drawn; Node size is proportional to its strength. BLUE is an acronym for Belgium-Luxembourg union.

4 Networks' Descriptive Analysis

Following Newman (2010), we compute basic descriptive statistics of the two networks, as shown in Table 1. The migration network features a more pronounced small-world property with a smaller average path length than in the FDI network, while the global clustering coefficient (transitivity) is almost double in the migration network. This implies that countries in the migration network have a higher tendency to form clusters i.e. if there are migration flows between countries *(A,B)*, and *(B,C)*, then there is a high probability for migration flows between countries *(C,A)*. The (strong) negative assortativity coefficients we find for both networks indicate that capital and migration relationships happen mostly between countries with different degrees.

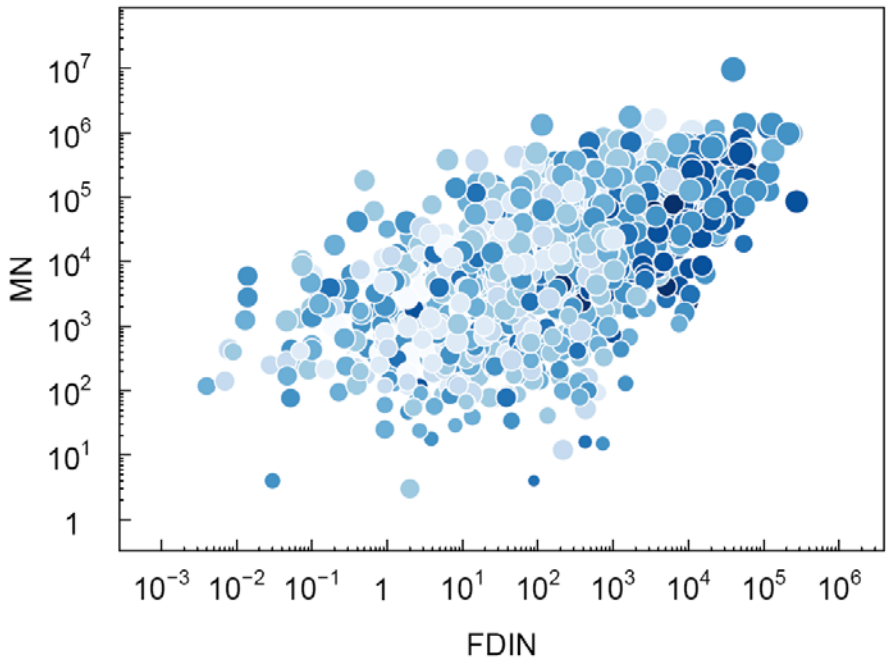
Table 1. Descriptive Network Statistics

	MN	**FDIN**
# nodes	218	237
# WCC	1	1
APL (Undirected)	1.743	1.927
Assortativity	-0.764	-0.638
Transitivity	0.328	0.187

Notes: Year 2000; MN: Migration Network; FDIN: FDI Network; WCC: Weakly Connected Component; APL: Average Path Length

We further study whether the two networks display any correlated behavior by exploring link weights' correlation, as shown in Figure 2. We find that a stronger link in the FDI network is typically associated with a stronger migration link and that this positive relation is indeed explained by countries' economic-, demographic- sizes and geographic distances, stimulating the adoption of a gravity-like equation in the next section.

Figure 2. Migration network (MN) versus FDI network (FDIN) link weights

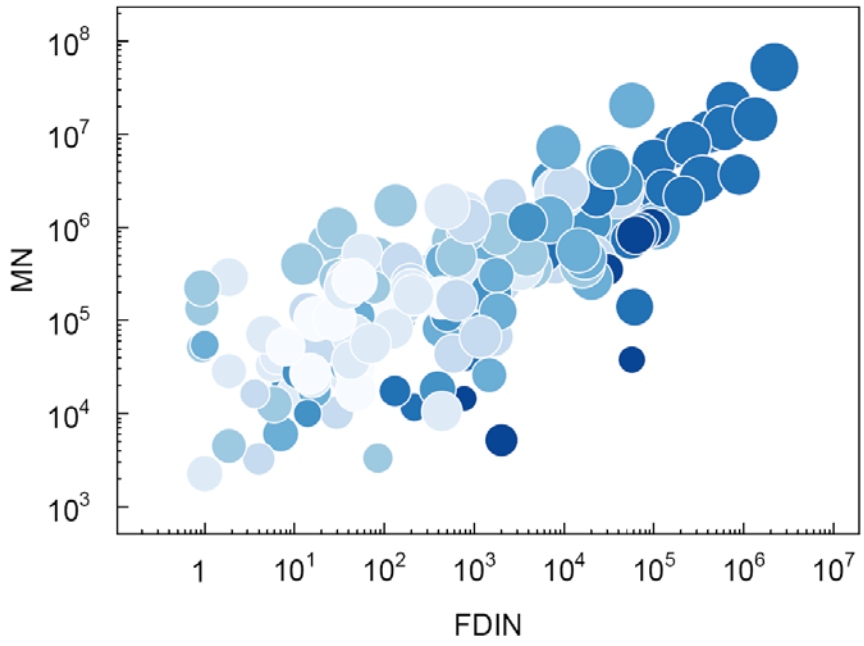


Notes: Logarithmic scale. Markers size is proportional to the logged product of country populations divided by country distance. Colors scale (from lighter to darker) is from lower to higher values of the logged product of countries' per capita GDPs divided by country distance.

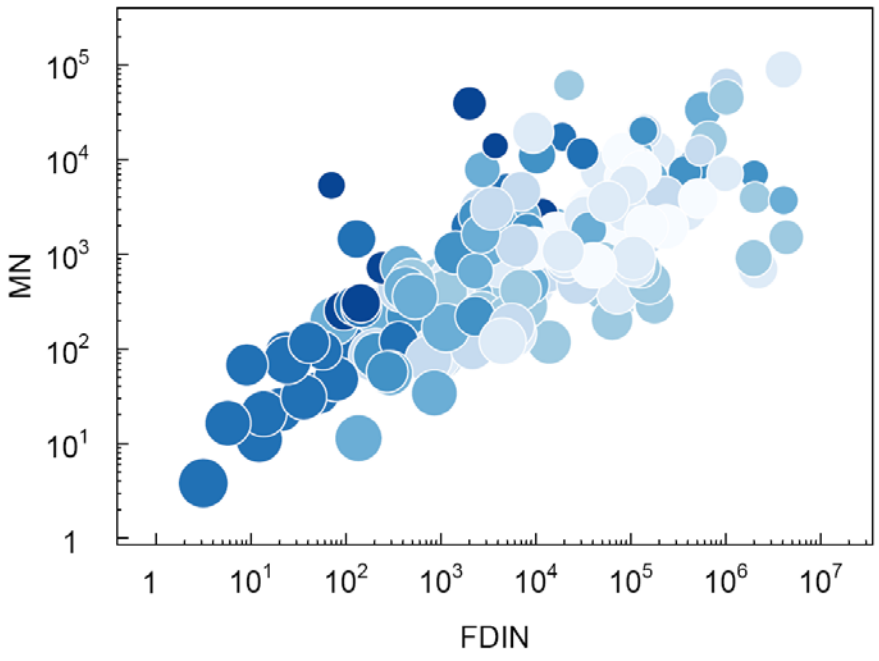
Next, we compare the two adjacency matrices: (i) counting the percentage of total matches (either ones or zeros), (ii) counting the percentage of FDI-network's links which are also present in the migration network and vice versa. We find 60% of total matches (either missing or present links) in the two networks. Moreover, 100% of FDI-network links are also present in the migration network whereas 60% of migration-network links are present in the FDI-network.

Finally, we compute the correlations between the two networks' node-statistics. Panel (a) in Figure 3 indicates that node's strengths are positively and linearly correlated in the two networks and this finding can be explained by countries' economic and demographic differences. Panel (b) indicates that Average Nearest Neighbor Strength (ANNS) is positively correlated in the two networks implying that if a country foreign-invests in a country that foreign-invests a lot, is also FDI-connected to countries that host a lot of immigrants. Again, demographic and economic country characteristics are associated with the above finding but now in a different manner: countries with larger ANNS are smaller and poorer.

Figure 3. Correlation of node network statistics between migration network (MN) and FDI network (FDIN).



(a)



(b)

Notes: Panel (a): Total strength; Panel (b): Average nearest-neighbor strength (ANNS); Marker size is proportional to logs of population; Colors scale (from lighter to darker) is from lower to higher (logged) values of GDP per capita.

5 Networks' Regression Analysis

In this section, we investigate whether highly connected countries in one network are also more connected in the other network. We further study whether network effects matter for the causal relationship between the two networks: we test if outward FDI of the OECD countries is positively related with (a) the number of migrants these two countries share, and (b) the centrality of those countries in the migration network (Table 2). Moreover, to control that our results are not driven by the identification issue that factor movements into a country may be caused by a demand shock, we additionally estimate only the one direction of migration –the opposite one to FDI: the effect of inward migration on outward FDI (Table 3). We first estimate the following equation, using Ordinary Least Squares with heteroskedasticity consistent standard errors:[5]

$$\begin{aligned}\log FDI_{ij} = {} & \alpha_1 \log(pop_i) + \alpha_2 log(pop_j) + a_3 log(pcgdp_i) + a_4 log(pcgdp_j) + a_5 colony_{ij} \\ & + a_6 comcur_{ij} + a_7 comleg_{ij} + a_8 contig_{ij} + a_9 language_{ij} + a_{10} gattd_{ij} \\ & + a_{11} euacp_{ij} + a_{12} \log(dist_{ij}) + a_{13} \log(areadiff_{ij}) + \beta tmig_{ij} + \gamma_1 ind_{ij} \\ & + \gamma_2 overin_{ij} + \gamma_3 \sim overin_{ij} + c_1 \\ & + \varepsilon_{ij}\end{aligned} \tag{1}$$

where FDI_{ij} is FDI of OECD-country i in country j; pop_j, pop_j and $pcgdp_i, pcgdp_j$ are countries' population and GDP per capita respectively. The dummy variables indicate whether the two countries have ever had a colonial link ($colony_{ij}$), share a common currency and legal system ($comcur_{ij}$ and $comleg_{ij}$ respectively), are contiguous ($contig_{ij}$), share a language spoken by at least 9% of the population in both countries ($language_{ij}$), have an EU to ACP economic partnership agreement ($euacp_{ij}$) and whether the FDI-host country j has signed the general agreement on tariffs and trade ($gattd_{ij}$). $dist_{ij}$ is longitudinal distance in kilometers between the main cities in i and j, while $areadiff_{ij}$ represents the value of the absolute difference of areas in square kilometers. $tmig_{ij}$ is the total bilateral migration stock, defined as

[5] Since we do not have time variation, (a) we do not include country-pair fixed effects and (b) the country fixed effects may be too drastic, removing too much of the information in migration stocks. We therefore try to measure country similarities more directly using geopolitical and socioeconomic dummies.

$tmig_{ij} = log(m_{ij}) + log(m_{ji})$, ind_{ij} is the total in-degree centralization, defined as the sum of the logs of the two countries in-degrees. With $overin_{ij}$ and $\sim overin_{ij}$ we study the role of third-country common and non-overlapping inward migration channels: $overin_{ij} = \sum_{\substack{k\neq i \\ k\neq j}} [log(m_{kj}) + log(m_{ki})]$, if $m_{kj} > 0$ and $m_{ki} > 0$ sums up the weights of commonly-shared inward (from third countries k) channels and $\sim overin_{ij} = \sum_{\substack{k\neq i \\ k\neq j}} [log(m_{kj}) + log(m_{ki})]$, if either $m_{kj} > 0$ or $m_{ki} > 0$ sums up link weights over all inward links originated from third countries k that only send migrants to either country i or country j. c_1 is a constant and ε_{ij} is the error term.

We further replace in equation (1) the total bilateral migration stock ($tmig_{ij}$) with the log value of the stock of migrants originated in country j (FDI-host country) and present in country i (FDI-parent country), demonstrating that our empirical results on factor movements between two countries are not driven by a demand shock. ind_i is the (log) in-degree centralization of the FDI-parent country.

$$\begin{aligned} \log FDI_{ij} = {} & \tilde{\alpha}_1 \log(pop_i) + \tilde{\alpha}_2 log(pop_j) + \tilde{\alpha}_3 log(pcgdp_i) + \tilde{\alpha}_4 log(pcgdp_j) + \tilde{\alpha}_5 colony_{ij} \\ & + \tilde{\alpha}_6 comcur_{ij} + \tilde{\alpha}_7 comleg_{ij} + \tilde{\alpha}_8 contig_{ij} + \tilde{\alpha}_9 language_{ij} + \tilde{\alpha}_{10} gattd_{ij} \\ & + \tilde{\alpha}_{11} euacp_{ij} + \tilde{\alpha}_{12} \log(dist_{ij}) + \tilde{\alpha}_{13} \log(areadiff_{ij}) + \tilde{\beta} \log(m_{ji}) + \tilde{\gamma}_1 ind_i \\ & + c_2 + \tilde{\varepsilon}_{ij} \end{aligned} \tag{2}$$

Note that the bilateral migrant stocks (*resp*. the inward migrant stocks) in a pair of countries (*resp*. in the FDI-parent country) increase the host country's FDI stock originated from the FDI-parent country. The impact of the control variables is strong, significant and signed as expected. We want to highlight that the addition of network statistics induces an increase in adjusted R-squared. The network variables have a negative and statistically significant effect on outward FDI (in both versions of the equation considered) implying that the more total immigrants a pair of country holds (*resp.* the FDI-parent country holds), the lower the parent country's FDI in the other country. In columns (3) and (4) we check whether this result is due to common versus non-overlapping channels and we find that inward migrants coming from third-party countries which are linked (a) either to FDI-parent country or to FDI-host country or (b) both to FDI-parent and

Table 2. Regression Results (Outward FDI and Total Migration)

	(1)	(2)	(3)	(4)
$log(pop_i)$	0.7947***	0.8346***	0.8315***	0.8003***
	(0.0427)	(0.0456)	(0.0456)	(0.0427)
$log(pop_j)$	0.5803***	0.5975***	0.5926***	0.5745***
	(0.0378)	(0.0388)	(0.0385)	(0.0378)
$log(pcgdp_i)$	2.7075***	2.8126***	2.7956***	2.7129***
	(0.0909)	(0.1004)	(0.0991)	(0.0910)
$log(pcgdp_j)$	0.8902***	0.9132***	0.9103***	0.9032***
	(0.0370)	(0.0382)	(0.0381)	(0.0382)
$colony_{ij}$	0.3902***	0.3661***	0.3709***	0.3844***
	(0.0910)	(0.0917)	(0.0914)	(0.0907)
$comcur_{ij}$	0.2066**	0.2100**	0.2072**	0.1988**
	(0.0930)	(0.0934)	(0.0935)	(0.0936)
$comleg_{ij}$	0.0993**	0.0936**	0.0944**	0.0976**
	(0.0471)	(0.0471)	(0.0471)	(0.0471)
$contig_{ij}$	0.4404***	0.4276***	0.4303***	0.4428***
	(0.0890)	(0.0887)	(0.0888)	(0.0888)
$language_{ij}$	0.2474***	0.2524***	0.2532***	0.2546***
	(0.0752)	(0.0750)	(0.0751)	(0.0747)
$gattd_{ij}$	0.0508	0.0402	0.0415	0.0520
	(0.0495)	(0.0498)	(0.0498)	(0.0498)
$euacp_{ij}$	0.2184***	0.2401***	0.2368***	0.2223***
	(0.0501)	(0.0512)	(0.0510)	(0.0502)
$log(dist_{ij})$	-0.1731***	-0.1650***	-0.1688***	-0.1520**
	(0.0584)	(0.0581)	(0.0581)	(0.0592)
$log(areadiff_{ij})$	-0.0890***	-0.0795***	-0.0796***	-0.0837***
	(0.0245)	(0.0248)	(0.0248)	(0.0246)
$tmig_{ij}$	0.1348***	0.1494***	0.1460***	0.1362***
	(0.0162)	(0.0172)	(0.0170)	(0.0162)
ind_{ij}		-0.0720**		
		(0.0301)		
$overin_{ij}$			-0.0631**	
			(0.0295)	
$\sim overin_{ij}$				-0.0405*
				(0.0208)
R^2	71.43%	71.53%	71.51%	71.48%
R^2 $Adjusted$	71.22%	71.31%	71.29%	71.26%
No of Observations	1,946	1,946	1,946	1,946

Notes: Dependent Variable: Outward FDI. Independent Variables: see text. Regressions are estimated by OLS and numbers in parentheses are heteroskedasticity-consistent standard errors. The symbols *, ** and *** reveal statistical significance at 10%, 5% and 1% respectively.

Table 3. Regression Results (Outward FDI and Inward Migration)

	(1)	**(2)**
$log(pop_i)$	0.9201***	1.0568***
	(0.0415)	(0.0573)
$log(pop_j)$	0.7049***	0.6617***
	(0.0342)	(0.0358)
$log(pcgdp_i)$	2.7616***	3.0121***
	(0.0993)	(0.1220)
$log(pcgdp_j)$	1.0088***	0.9931***
	(0.0335)	(0.0340)
$colony_{ij}$	0.4878***	0.4470***
	(0.0940)	(0.0943)
$comcur_{ij}$	0.2471***	0.2450***
	(0.0938)	(0.0942)
$comleg_{ij}$	0.1202**	0.1174**
	(0.0483)	(0.0483)
$contig_{ij}$	0.5215***	0.5037***
	(0.0916)	(0.0909)
$language_{ij}$	0.3215***	0.3122***
	(0.0758)	(0.0740)
$gattd_{ij}$	0.0749	0.0812
	(0.0504)	(0.0502)
$euacp_{ij}$	0.2584***	0.2696***
	(0.0511)	(0.0511)
$log(dist_{ij})$	-0.2613***	-0.2386***
	(0.0609)	(0.0607)
$log(areadiff_{ij})$	-0.0767***	-0.0612**
	(0.0249)	(0.0252)
$\log(m_{ji})$	0.1096***	0.1554***
	(0.0258)	(0.0284)
ind_i		-0.1959***
		(0.0567)
R^2	70.58%	70.76%
$R^2\ Adjusted$	70.37%	70.54%
No of Observations	1,946	1,946

Notes: Dependent Variable: Outward FDI. Independent Variables: see text. Regressions are estimated by OLS and numbers in parentheses are heteroskedasticity-consistent standard errors. The symbols *, ** and *** reveal statistical significance at 10%, 5% and 1% respectively.

FDI-host country are FDI marring. The above results suggest that in contrast to migration effects, capital flows from FDI-parent country to FDI-host country may decrease due to countries' (*resp.* FDI-host country's) weighted connectivity in the migration network.

6 Conclusions

Throughout the world, economies are becoming rapidly integrated and the level of dependence between them increases exponentially. Globalization has led to a rapid growth in the flow of factors of production across borders. From 1980 to 2010, there has been an increase of about 65 million in the foreign population in the OECD countries, while the volume of FDI grew four times as fast as world output during the same period. The international flow of people and capital are important features of this integrated global economy and taken together, the international investment channels and the migration corridors constitute a convoluted and complicated web of relationships among countries.

This paper has explored the properties and the link between migration and FDI on a complex-network perspective. Diasporas in the OECD attract FDI to their origin countries and this result can be mostly explained by countries' economic, demographic and geographic characteristics. We have also found that outward FDI can be explained by countries' centrality in the international migration network and, interestingly, our results indicate that the larger the number and the "diameter" of third-party (countries) inward migration "tubes" that "debouche" in any two countries, the lower the stock of capital in the FDI-host country hold from the FDI-parent country. Perhaps, more generally, the results reported above are intended to demonstrate that it is feasible and realistic to model the world economy as a complex network, where nodes and links represent countries and economic-interaction channels respectively and that, in doing so, we can advance the macroeconomic analysis in interesting and meaningful ways.

Overall, we were able to provide statistically and economically significant results for the relationship between FDI and migration through our complex-network analysis. However, we do believe that there is space for improvement of this approach. Particularly, we suggest an examination of a wide set of immigrant characteristics which, along with our network variables could provide further insight on the relationship between human migration and FDI. Higher frequency of the migration data should also provide a considerable improvement for future

studies since so far migration datasets are based on censuses conducted every ten years, while FDI data are updated annually, creating a frequency mismatch. Finally, the focus on the current paper was placed on direct investment that generally builds on a wide network of economic agents, requiring a long-run focus on the characteristics of the host country. Thus, the examination of how human migration affects short-term portfolio investment flows could provide us with interesting results. Any future amendments in our complex systems' approach can lead us in a deeper understanding of the theory connecting migration and foreign investment and the macroeconomic empirical analysis in general.

REFERENCES

Barry, F., 2002. Foreign direct investment, infrastructure and the welfare effects of labour migration. The Manchester School 70, 364-379

Battiston, S., Rodrigues, J.F., Zeytinoglu, H., 2007. The network of inter-regional direct investment stocks across Europe. Advances in Complex Systems 10, 29-51

Bergstrand, J.H., Egger, P., 2007. A knowledge-and-physical-capital model of international trade flows, foreign direct investment, and multinational enterprises. Journal of International Economics 73, 278-308

Bhattacharya, U., Groznik, P., 2008. Melting pot or salad bowl: some evidence from US investments abroad. Journal of Financial Markets 11, 228-258

Blonigen, B.A., Davies, R.B., Waddell, G.R., Naughton, H.T., 2007. FDI in space: Spatial autoregressive relationships in foreign direct investment. European Economic Review 51, 1303-1325

Buch, C.M., Kleinert, J., Toubal, F., 2006. Where enterprises lead, people follow? Links between migration and FDI in Germany. European Economic Review 50, 2017-2036

Clemens, M.A., Williamson, J.G., 2000. Where did British Foreign Capital Go? Fundamentals, Failures and the Lucas Paradox: 1870-1913. National Bureau of Economic Research

Fagiolo, G., Mastrorillo, M., 2013. International migration network: Topology and modeling. Physical Review E 88, 012812

Fagiolo, G., Mastrorillo, M., 2014. Does human migration affect international trade? A complex-network perspective. PloS one 9, e97331

Flisi, S., Murat, M., 2011. The hub continent. Immigrant networks, emigrant diasporas and FDI. The Journal of Socio-Economics 40, 796-805

Foad, H., 2012. FDI and immigration: a regional analysis. The Annals of Regional Science 49, 237-259

Foley, C.F., Kerr, W.R., 2011. Ethnic innovation and US multinational firm activity. National Bureau of Economic Research

Gao, T., 2003. Ethnic Chinese networks and international investment: evidence from inward FDI in China. Journal of Asian Economics 14, 611-629

Head, K., Ries, J., 2008. FDI as an Outcome of the Market for Corporate Control: Theory and Evidence. Journal of International Economics 74, 2-20

Hunt, J., 2004. Are migrants more skilled than non-migrants? Repeat, return, and same-employer migrants. Canadian Journal of Economics/Revue canadienne d'économique 37, 830-849

Javorcik, B.S., Özden, Ç., Spatareanu, M., Neagu, C., 2011. Migrant networks and foreign direct investment. Journal of Development Economics 94, 231-241

Kugler, M., Rapoport, H., 2005. Skilled emigration, business networks and foreign direct investment. CESifo Working Paper Series No 1455

Kugler, M., Rapoport, H., 2007. International labor and capital flows: Complements or substitutes? Economics Letters 94, 155-162

Leblang, D., 2010. Familiarity breeds investment: Diaspora networks and international investment. American Political Science Review 104, 584-600

Ligthart, J., Singer, D., 2009. Do Immigrants Promote Outward Foreign Direct Investment? Evidence from the Netherlands. Unpublished, Tilburg University

Newman, M., 2010. Networks: an introduction. Oxford University Press.

Parsons, C.R., Skeldon, R., Walmsley, T.L., Winters, L.A., 2007. Quantifying international migration: a database of bilateral migrant stocks. World Bank Policy Research Working Paper

Razin, A., Sadka, E., 2007. Corporate transparency, cream-skimming and FDI. European Economic Review 51, 1263-1276

Schweitzer, F., Fagiolo, G., Somette, D., Vega-Redondo, F., White, D.R., 2009. Economic Networks: What do we know and what do we need to know? Advances in Complex Systems 12, 407-422

Tong, S.Y., 2005. Ethnic networks in FDI and the impact of institutional development. Review of Development Economics 9, 563-580

UNCTAD, 2006. World Investment Report 2006: FDI from Developing and Transition Economies: Implications for Development (New York and Geneva: United Nations)

Wei, S.-J., 2000. How taxing is corruption on international investors? Review of economics and statistics 82, 1-11